The outside of the bulb was silvered, observations taken, and the silver then dissolved without touching the suspension, and observations again taken.

Silvered surface ..	9·898 sec.	log. dec.	0·20718
Glass " ..	9·938 "	"	0·20751

Ratio of frictions 1 : 1·00564.

The change is thus less than 0·6 per cent., and is within the limits of experimental error.

The main part of Helmholtz's paper is taken up with the consideration of experiments on the oscillations of an accurately worked sphere. It is remarkable that he deduces a value for the coefficient of viscosity which is about a quarter greater than that given by Poiseuille. This seems to suggest that a slight change in the application of theory to the results of experiment is needed, which will reduce the coefficient for the viscosity of the liquid, and increase the value for its adhesion to the walls of the vessel to that required for the condition of no slip. The existence of any effect approaching in magnitude that given by Helmholtz would produce, as I have shown, such an enormous change in the time of flow through a silvered tube, that the result of my experiments must be considered quite conclusive. The argument from the differences in friction due to differences in surface, in favour of the contact theory of E.M.F. is now seen to be worthless; and it must be admitted that no slip occurs, at any rate with solids that are wetted by the liquid.

III. "Re-determination of the True Weight of a Cubic Inch of Distilled Water." By H. J. Chaney. Communicated by the President. Received February 4, 1890.

(Abstract.)

Recent investigations as to the value of the metric unit of volume —the cubic decimetre—appear to show, indirectly, that the present weight of a cubic inch of distilled water (252·458 grains, $t = 62°$ F., $b = 30$ in.)—the hitherto accepted unit of volume in this country—is appreciably too high. This weight (252·458 grains) is based on weighings made by Shuckburgh in 1798, and on linear measurements by Kater in 1821; but their results are affected by uncertainty as to thermometric and linear measurements, and as to the condition of the water used. Hence a direct re-determination of the unit of volume in this country appeared now to be desirable.

Methods and Apparatus Employed.

The weight of a given volume of water is best determined by ascertaining the weight of water displaced by a body or gravimeter, whose weights in air and *in vacuo*, and external linear dimensions, may be precisely determined. For the purpose of the present experiments three such gravimeters were used :—

C. A platinised hollow bronze circular cylinder, 9 inches in diameter and height.

Q. A quartz cylinder, 3 inches in diameter and height.

S. A hollow 6-inch brass sphere.

The dimensions of C, Q, and S were measured by two comparators, designed for these measurements, geometric lines being traced on C and S for this purpose; to $\frac{1}{100000}$th part of an inch. The actual rate of expansion of each gravimeter by heat was not separately determined, as the probable errors which arise in ascertaining the rates of expansion of bodies of the particular sizes and forms of C, Q, and S, would be larger than the probable errors which arise in applying the rates of expansion obtained from experiments made by the Fizeau optical method on smaller cubes of similar materials.

Water.—For the rate of the expansion of water the mean corrected observations of Despretz, Kopp, and Pierre, as taken by W. H. Miller (1856), and Foerster (1864), have been followed. If those of Hägen and Mathiessen had been included, the weight of the cubic inch would have been affected by $\pm$ 0·0009 grain. For the normal temperature to which we wish to reduce the cubic inch ($t = 62°$ F.), the maximum density of water to its density at $t = 62°$ F. is—

$$\frac{\text{at } 4^{\circ}\text{ C.} = 1{\cdot}000000}{t_{62^{\circ}\text{ F.}} = 0{\cdot}998881}.$$

The water was in each case twice distilled; no chlorine, carbonic acid, lead, or lime, being traced, in any quantity to affect the weighings. No correction for the absorption of air was applied, as the distilled water was so far deprived of air, by boiling, and under an air-pump.

Thermometers.—Six standard thermometers, verified both before and after the experiments were used, viz., Centigrade 4517, 4518 (Tonnelôt) ; Fahrenheit 430 (Kew Committee), 12765 (Negretti and Zambra), and 20065 (Hicks) ; the verifications being based on the two thermometers 4517 and 4518, the values of which had been expressed by Dr. René Benoît and Dr. Pernet in relation to the hydrogen thermometers to $\pm$ 0·001° C., each thermometer being corrected for exterior pressure, and its readings reduced to the horizontal position. The experiments were made as nearly at 62° as

might be; an uncertainty of 0·2° F. making a difference in the weight of the cubic inch of 0·003 grain.

Weighings.—The weighings were made in three sensitive balances, by Borda's method; the gravimeter being suspended in water to a fixed depth, by a platinum wire. The largest errors in such weighings are those likely to arise from minute bubbles of air carried down by the body which is suspended in water; and as it is impracticable to keep the gravimeter in boiling water, such bubbles must be looked for, and the gravimeter repeatedly re-immersed.

The normal air adopted in these weighings is that at $t = 62°$ F., $b = 30$ inches, containing four volumes of carbonic-anhydride in every 10,000 volumes of air; and also containing two-thirds of the amount of aqueous vapour contained in saturated air; weighed at Westminster, latitude 51° 29′ 53″, at 16 feet above sea-level (g Westminster $= g_{45°} - 1·00057704$). A cubic inch of such air weighs 0·3077 grain.

Results of the present Experiments.

C. Mean height........	9·002020 inches.
,, diameter......	9·004148 ,,
V_c..............	572·803651 cubic inches.
Weight in air.......	183676·066 grains.
,, *in vacuo*...	183797·198 ,,
ΔC..............	1·27049
S. Mean diameter.......	5·992439 inches.
V_S..............	112·6694096 cubic inches.
Weight in air	28410·307 grains.
,, *in vacuo*...	28440·779 ,,
Q. Mean diameter	3·083991 inches.
,, height	3·018485 ,,
Weight in air.......	15426·95495 grains.
,, *in vacuo*...	15429·55515 ,,
ΔQ..............	2·265425
V_Q..............	23·04014 cubic inches.

In normal air a cubic inch of distilled water, freed from air, at the temperature of 62° F., was found to weigh—

C..........	252·267 grains.
S..........	252·301 ,,
Q..........	252·261 ,,

By the experiments with the sphere, apparently greater accuracy was obtained than with the cylinders, and in calculating the weight of the cubic inch, a higher value has been assigned to S; or

One cubic inch of water (as above) = grains $252\cdot286 \pm 0\cdot002$,

of which grains the imperial pound ($t = 62°$, $b = 30$ inches) contains 7,000.

IV. "On Wind Pressure upon an Inclined Surface." By W. H. Dines, B.A. Communicated by the Meteorological Council. Received June 12, 1890.

In accordance with a plan suggested in a memorandum drawn up by Professor Darwin, I have made the following experiments upon this subject, using for the purpose the large whirling machine of 56 feet diameter erected at Hersham.

The apparatus was made by Mr. Munro, and the general arrangement is shown in figs. 1, 2, and 3.

Fig. 1 gives a view as seen from the point towards which the pressure plate P is moving; fig. 2 as seen from the centre of the whirling machine; and fig. 3 as seen from a point vertically above it.

Fig. 1.